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# The Economic Importance of Adequate Aeronautical Telemetry Spectrum

*73rd MORS Symposium*
*West Point*

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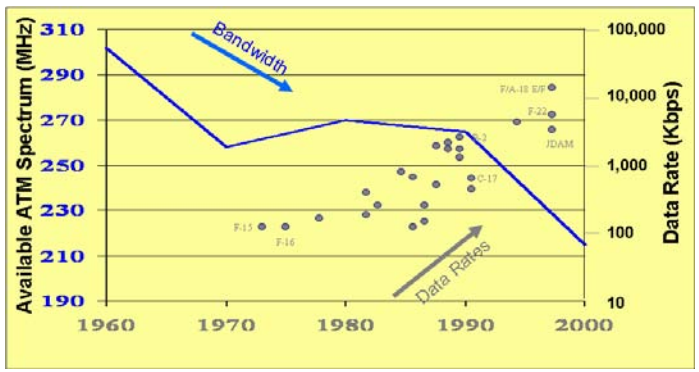
# Outline

- Introduction
- Context & scope
- Overview of economic model
- Methodology
- Preliminary results

# Introduction

- The flight test community faces a telemetry spectrum crunch
- Amount of spectrum now allocated for ATM is not sufficient to meet needs and requirements have been steadily growing




- ATM spectrum is vital to both commercial and military flight testing
- There are economic implications associated with the allocation of spectrum for ATM
- Economic considerations are important to the proposal currently before the ITU
  - Agenda Item 1.5 of WRC 2007 calls for the allocation of additional spectrum for wideband ATM in the 3-30 GHz band



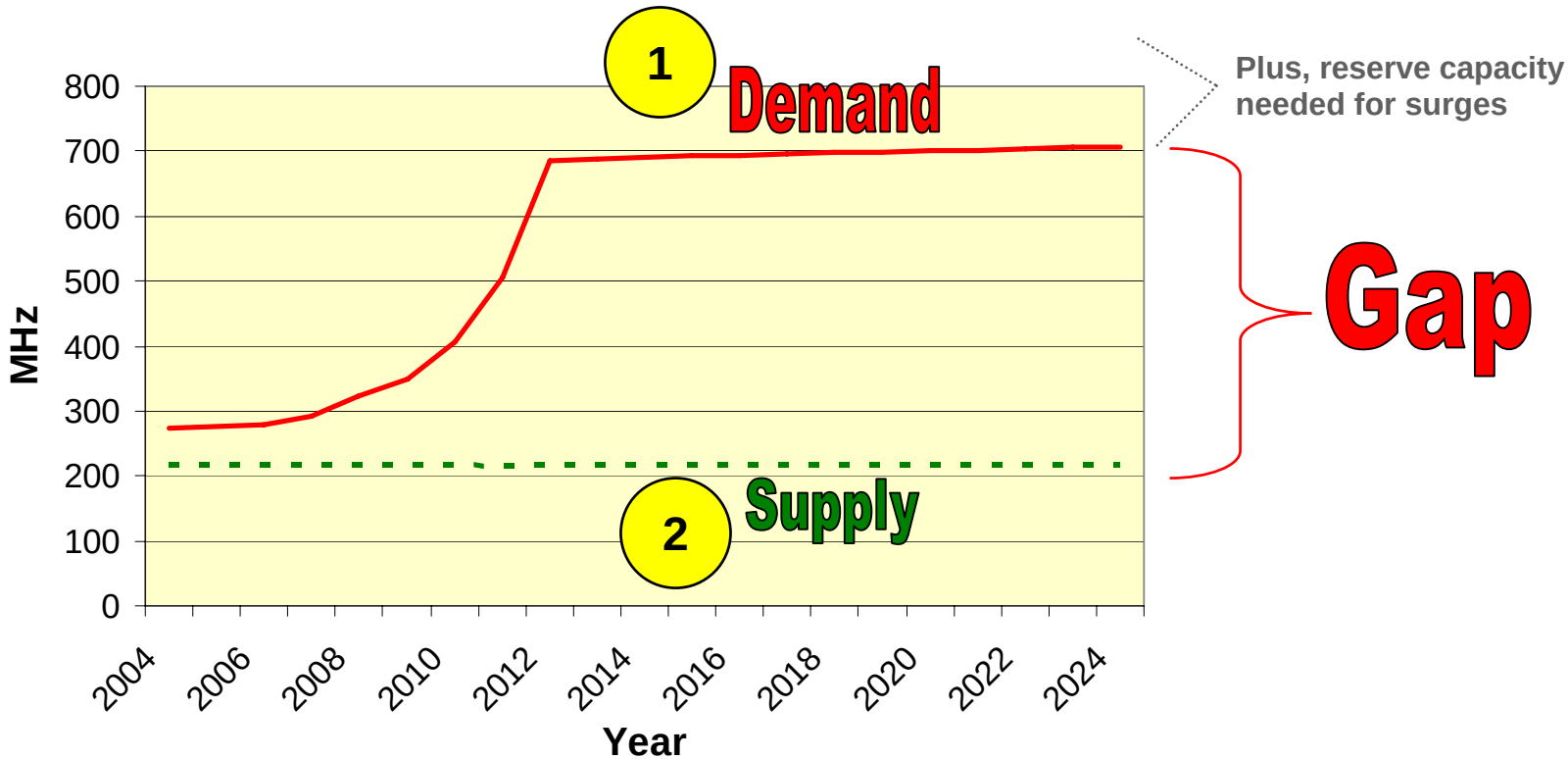
ATM: Aeronautical Telemetry; MHz: Megzhertz; Kbps: Kilobits per second; ITU: International Telecommunication Union; WRC: World Radio Conference; GHz: Gigzhertz

# Context & Scope

- MITRE tasked to build a model to evaluate the economic importance of having adequate accessibility to ATM spectrum
- MITRE team developed robust economic analysis methodology to forecast future scenarios
  - Exercised conservatism in modeling costs

# Overview of Economic Model *(1 of 2)*

- **MITRE team established probable future scenarios on a test range over a twenty year period (2004-2024)**
- **Current supply and estimated demand of ATM spectrum on a range on an annual basis over 20 years**
  - **Calculated the resulting "gap"**




ATM: Aeronautical Telemetry; MHz: Megahertz

# Overview of Economic Model *(2 of 2)*

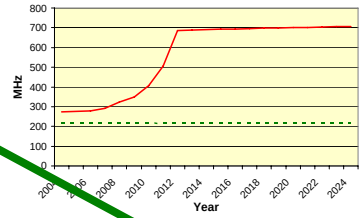
- **Identified and estimated cost impacts of the Gap**

3 Technology Investments

4 Test Delays

5 Test Infrastructure Enhancements

6 Inadequate Testing




Gap

- **This insight substantiates the criticality of spectrum augmentation**

# Methodology – Demand & Supply

1

**Demand**

Current spectrum shortfall
Geographic reuse loss
Growth rate
Major test program requirements
Schedule overhead

- Greater system complexity
- High definition video
- Shorter acquisition cycles

Gap

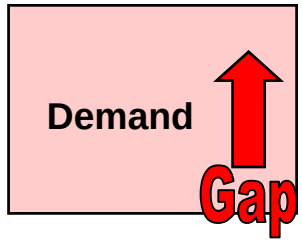
2

**Supply**

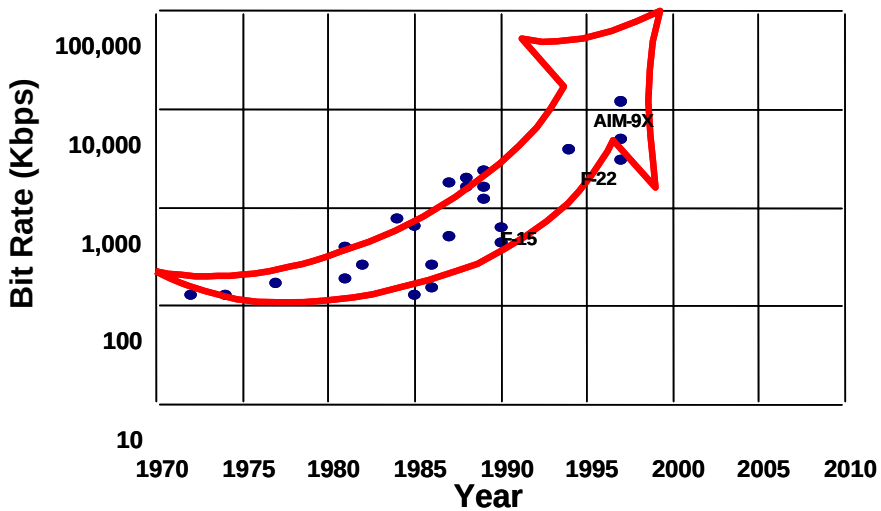
Current/future allocation
Potential WRC augmentation
Adoption rate for new spectrum

1

# Methodology – Demand *(1 of 2)*




- **Demand is defined as requirements for ATM spectrum**
- **Model applies well-accepted projections**
  - **Current ATM shortfall in spectrum-congested area is 17%***
  - **Geographic reuse loss in spectrum-congested area is 8%***
  - **ATM spectrum growth has and will continue to follow Moore's Law**

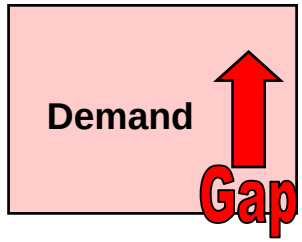



  - **Step-wise growth estimates incorporate benefit of technology investments**

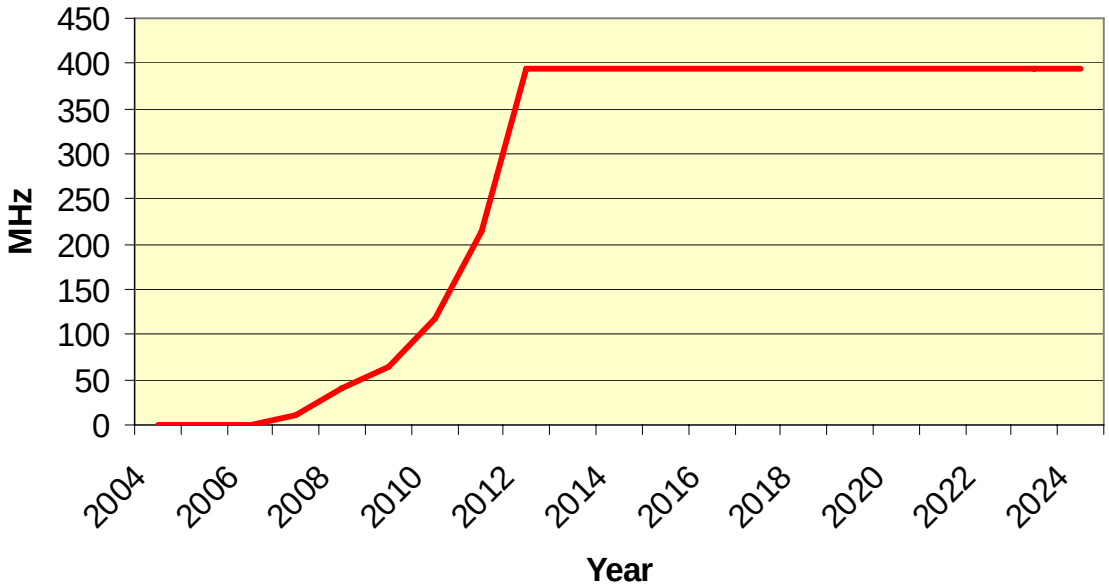
ATM: Aeronautical Telemetry; Kbps: Kilobits per second;
*Sarnoff Requirements Study

1

# Methodology – Demand *(2 of 2)*



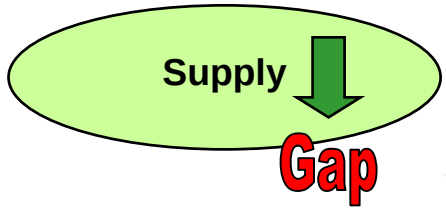

- **Model incorporates new (conservative) demand findings**
  - **Schedule overhead of 10%**
  - **Major test program requirements:**



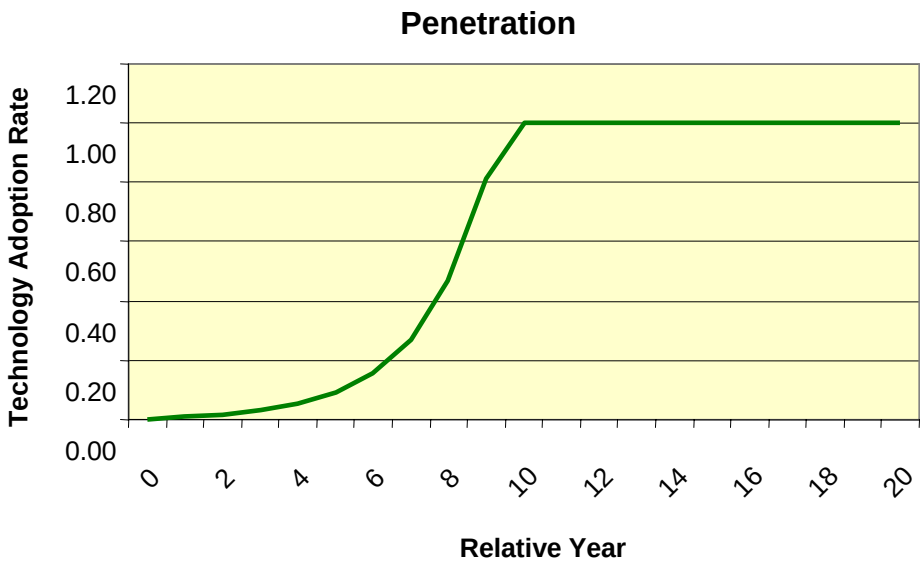

MHz: Megahertz

2

# Methodology - Supply



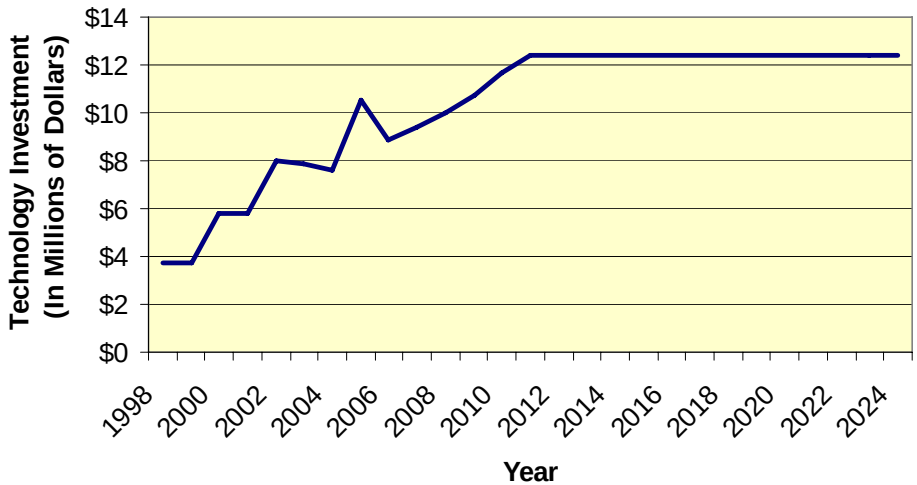

- Supply is defined as spectrum that may be used for ATM
- Current allocation of 215 MHz
- Developed scenarios to evaluate potential spectrum augmentation from WRC (0 to 650 MHz)
  - New technologies needed to access additional spectrum
    - Adopted over time by range and program managers



3

# Methodology – Technology Investment

- There are costs and potential benefits of investments in technology research initiatives
- Estimated annual investment costs for ARTM, Tier 1 & 2 technologies, iNet, use of very high frequency bands (e.g., 8 GHz), and other unforeseen, promising technologies




- Potential benefits (e.g., improved efficiencies) of these investments are incorporated within growth rates of demand data



ARTM: Advanced Range Telemetry; iNet: Integrated Network Enhanced Telemetry; GHz: Gigahertz

4

# Methodology – Cost of Delays

- There are costs associated with unplanned test delays due to insufficient ATM spectrum access
- There are unplanned delays on a test range today
  - One large test delay per week costs $1M
  - Three small test delays per week cost $50K x 3 = $150K

- Today, test delays due to insufficient ATM spectrum access cost $60M per year!



ATM: Aeronautical Telemetry; M: Million; K: Thousand

5

# Methodology – Test Infrastructure Enhancements

- Examined cost to provide new or additional range resources for flight testing in different geographic areas
  - Huge cost to programs and national economy
- Issues remain:
  - Are there alternative ranges available far enough away from existing ranges to allow for spectrum reuse?
  - Will legal, environmental, and political consent be given to provide new range resources far enough away from existing ranges accessing ATM spectrum to allow for spectrum reuse?

- In the present environment, these are not realistic options!

# Methodology – Inadequate Testing

- Model incorporates cost of inadequate testing
- Lack of access to ATM spectrum leads to test point shedding which leads to reduction in test quality
- At some point, not testing results in catastrophes and fatalities
- Based on specific cost of inadequate testing case

- **30 lives lost!***
  - GAO: in part due to inadequate test & evaluation**
    - To meet cost and schedule targets, actual testing conducted was less then a third of that originally planned
- **$1.6B per incident!***

ATM: Aeronautical Telemetry; B: Billion; *Calculation based on Research, Development, Test, and Evaluation data in internal DoD document; **GAO, 20 February 2001, http://www.gao.gov/new.items/d01369r.pdf

# Preliminary Results




- Costs are significantly mitigated by:
  - Reducing testing delays (via spectrum augmentation and/or test infrastructure enhancements)
  - Decreasing inadequate testing
- Model does not incorporate the risk of depending on test infrastructure enhancements
  - Legal, environmental, political, and large upfront investment hurdles may not be overcome
  - In present environment, not a realistic option

- WRC spectrum augmentation of 650 MHz is only scenario in which requirements are met

- Our choices today will determine how we will flight test in the future
- Will we be able to efficiently develop innovative aerospace products?



WRC: World Radio Conference; MHz: Megahertz;

Command, Control, Communications Center

# Back-Up

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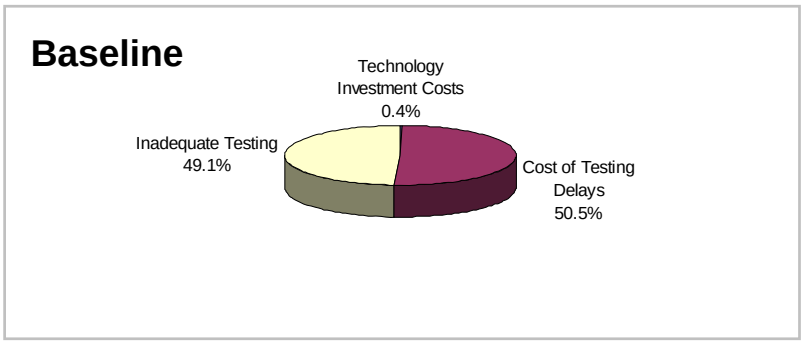
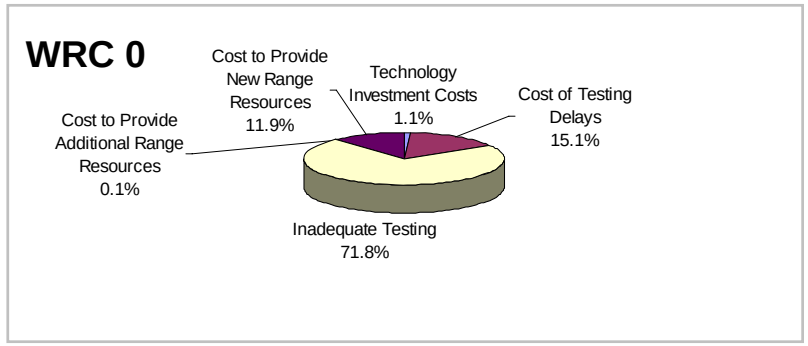
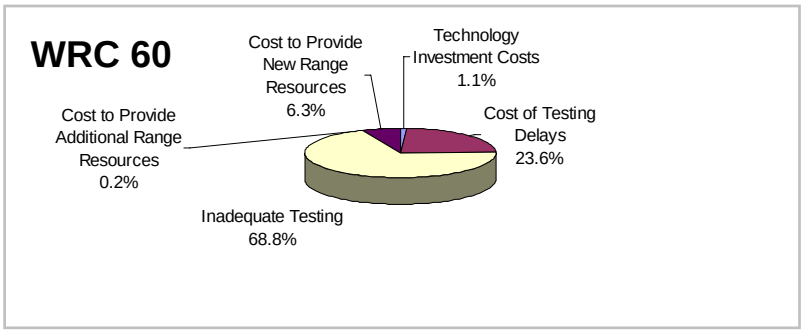
# Scenario Definitions

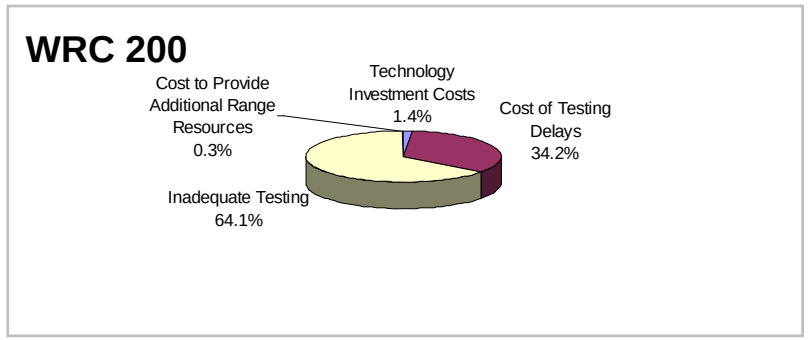
| Scenarios | Year Requirements Are Met | Mitigated Year 2024 Gap | New Range Resources | Yearly Accident Rate | Schedule Overhead | Adoption Rate | Spectrum Augmentation |
|---|---|---|---|---|---|---|---|
| Baseline | Never | 491 | No | 1.00 | Yes | Med | 0 |
| WRC 0 | Never | 31 | Yes - 2 | 0.50 | Yes | Med | 0 |
| WRC 60 | Never | 108 | Yes 1 | 0.45 | Yes | Med | 60 |
| WRC 200 | Never | 146 | No | 0.35 | Yes | Med | 200 |
| WRC 650 | 2016 | (159) | No | 0.00 | Yes | Med | 650 |

# Cost Components




- **Dollar value of tech investment costs remain constant**
- **Baseline: roughly equal split of remaining costs**
- **In WRC cases:**
  - **Cost of testing delays: 15.1% to 50.5%**
  - **Cost of additional range resources: 0.1% to 0.3%**
  - **Cost of new range resources: 6.3% to 11.9%**
  - **Inadequate testing: 0% to 49.1%**